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ADOLF VON BAEYER'S COLLECTED WORKS.

Adolf von Baeyer's gesammelte Werke. Herausgegeben zur Feier des siebzigsten Geburtstages des Autors von seinen Schülern und Freunden. Erster Band, pp. cxxxii+990. Zweiter Band, pp. 1194. (Brunswick: F. Vieweg und Sohn, 1905.)

AS we examine these two splendid volumes we cannot but feel that no better way of commemorating the seventieth birthday of Adolf von Baeyer could possibly have been found than that of collecting together his researches and publishing them so that they might be studied in their entirety by all students of chemistry.

The publication of the complete researches of an investigator who has had a profound influence on the scientific thought of his time has much to recommend it, since the collected works form not only a memorial to the investigator, but also enable others to gain an insight into the train of thought which preceded the gradual development of each important discovery.

The present volumes have, moreover, a special interest since they have been produced under the personal supervision of Baeyer himself, with the result that the vast amount of work which he has accumulated during the fifty years of his active life is arranged in the manner which he himself wished and thought most suitable.

These volumes contain as frontispiece a strikingly lifelike portrait of Baeyer. The introduction contains a most interesting sketch of Baeyer's life (1835–1905) from his own pen, which enables the reader to form a very vivid idea of the difficulties Baeyer had to encounter in the earlier days of his scientific career. Not only were the schools of chemistry which existed at that time few in number and the appliances even in the best of them only of a very elementary kind, but research in organic chemistry was still quite in its infancy, and therefore every new development was of the nature of pioneer work.

Although in his grandfather's house Baeyer was in his early years brought into contact with Paul Heyse, Geibel, Fontane, and other literary giants of the time, he showed no inclination towards literature, and soon began to develop a love for science by taking a keen interest in chemistry, botany, physics, and mathematics.

In 1856 he decided to devote himself seriously to chemistry, and became a student in Bunsen's laboratory at Heidelberg at a time when Roscoe, Pebal, Lieben, Beilstein, Lothar Meyer, and others were working in the laboratory, and when Bunsen's reputation as a teacher and investigator was at its highest. His first original investigation was a continuation of the work of Bunsen and Roscoe on the combination of hydrogen and chlorine, and this, as well as his next research, on methyl chloride, were suggested by Bunsen. After this Baeyer worked entirely on his own initiative, and gradually laid the foundations upon which the great edifice of his life-work was subsequently raised.

The papers collected together in the two volumes before us have been grouped by Baeyer under the following headings:—(1) The organic arsenic compounds; (2) the uric acid group; (3) indigo; (4) papers arising from the researches on indigo; (5) pyrrol and pyridine bases; (6) experiments on the elimination of water and on condensation; (7) the phthaleins; (8) the chemistry of the hydroaromatic compounds; (9) the terpenes; (10) nitroso-compounds; (11) furfurol; (12) acetylene compounds and the "Spannung's Theorie"; (13) peroxides; (14) the basic properties of oxygen; (15) dibenzalacetone and triphenylmethane; (16) various researches in the aromatic series; (17) various researches in the aliphatic series; (18) nomenclature; (19) diversa.

The titles alone will serve to convey some idea of the immense range of subjects which have claimed the attention of Baeyer, and as we study each of these sections we meet always the same characteristics—great skill in overcoming experimental difficulties (often necessitating the working out of entirely new methods of attack), and great ability in deducing the correct theoretical explanation from the results of experiment.

Within the necessarily limited space of this review it is, of course, impossible to discuss in any detail even the most far-reaching of Baeyer's discoveries or to attempt to follow their historical development.

Attention may, however, be briefly directed to some characteristics of Baeyer's work which will probably strike the reader most as he studies the successive sections into which these researches are divided.

The researches on uric acid, which date from 1860, are marvels of experimental skill, including, as they do, the discovery and characterisation of barbituric acid, violuric acid, and many other new members of this important group, and this at a time when the structure and relationship of the more important members of this section of organic chemistry were little understood. Baeyer was naturally interested in the problem of the synthesis of uric acid, and in 1863 he endeavoured to accomplish this by combining uramil with potassium cyanate, when he obtained pseudo-uric acid, an acid which contains one molecule of water more than uric acid itself. The synthesis was completed in 1895, when E. Fischer and L. Ach showed that pseudo-uric acid is converted into uric acid when it is melted with anhydrous oxalic acid.

Of great interest, not only from a purely scientific, but also from the commercial point of view, are the sections on the phthaleins and on indigo. The researches on the phthaleins must have required exceptional skill, ingenuity and patience, because it must be remembered that this work was absolutely new, and, moreover, the substances belonging to this class are, at the present day, some of the most difficult to deal with experimentally.

The well-known papers on indigo should be read in connection with a most interesting sketch of their historical development (p. xxxviii) which Baeyer himself has contributed.

The labour entailed in carrying out these researches must have been very great, and it is instructive to read that, after a certain time, Baeyer became so

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wearied with indigo that he was quite unable to continue experimenting on the subject, and had to allow the various problems connected with the commercial development of his discoveries to pass into other hands. In search of fresh fields for investigation, Baeyer commenced an inquiry with the object of discovering whether carbon atoms, uncombined with hydrogen, are capable of uniting to form long chains, and, in order to determine this, he synthesised a number of poly-acetylene compounds, including tetracetylene-dicarboxylic acid

$$CO_2H.C{\equiv}C{-}C{\equiv}C{-}C{\equiv}C{-}C{\equiv}C.CO_2H.$$

This remarkable acid is quite colourless, but is readily blackened by the action of light, and compounds of this type were found to be so explosive that their further investigation had to be abandoned. One of the fruits of the consideration of the properties of these compounds was the enunciation of the well-known "Spannung's Theorie," which has given rise to so much discussion, and proved to be of such value in suggesting new lines for experimental inquiry.

Section viii., which Baeyer has placed directly after the phthaleins, deals with the chemistry of the hydroaromatic compounds and the constitution of benzol. These researches date from the year 1866, when, in conjunction with Graebe, Born, Mohs and others, he first investigated the behaviour of phthalic acid and terephthalic acid towards sodium amalgam.

Baeyer repeatedly returned to this subject in later years, but it was not until 1888 that the epoch-making series of papers "Ueber die Constitution des Benzols" began with the exhaustive study of the products which are formed when terephthalic acid is reduced with sodium amalgam. These researches on the reduction products of the phthalic acids and of benzene itself are well known, but they have perhaps hardly received the close attention which they merit, owing partly, no doubt, to their difficult and intricate nature. The careful study of these papers will, however, more than repay the time spent, and to the young investigator they may well serve as an example of the patience and endurance which he must be prepared to face if he wishes to attempt the solution of a problem of really first-rate importance.

It is perhaps a consequence of the study of these artificially prepared reduction derivatives of benzene that Baeyer was led to investigate that wonderful series of naturally occurring reduced benzene derivatives—the terpenes—the constitution of which has offered one of the most difficult problems to the modern organic chemist. During the course of his experiments on the oxidation of substances which, like the terpenes, contain unsaturated closed chains, Baeyer commenced to experiment with Caro's acid, and, among many other interesting results, showed that this acid was a most valuable reagent for the conversion of ketones into lactones. Further experiments resulted in the discovery of the remarkable series of peroxidised substances of which benzoylhyperoxide and diethylperoxide may be taken as types, and led to a development of Collie and Tickle's important work on the tetravalent nature of oxygen and the oxonium theory.

Baeyer's latest publications deal with the vexed question of the relation of colour to constitution, and are concerned especially with the reason for the coloured nature of certain salts derived from dibenzalacetone and from triphenylcarbinol. One of the most remarkable results of this investigation is the proof that the coloured salts of triphenylcarbinol are in reality esters possessing the properties of salts, and that they cannot be regarded as quinoid compounds.

Baeyer is, at the present time, occupied with the further development of this important matter.

It is impossible to close the volumes before us without marvelling at the immense amount of work which it is possible for one man to carry out, and without a deep impression of the enormous influence which the work of Baeyer has had on the development of modern chemistry. The list of papers published from Baeyer's laboratory occupies no less than sixty-three pages of closely-printed matter, and when we look at the names attached to these papers we are able to form some idea of the magnitude of the school which he has founded, and of the extent to which many of the greatest chemists of the day owe their training in research to Baeyer. W. H. PERKIN, JUN.

A STANDARD TREATISE ON ELASTICITY.

A Treatise on the Mathematical Theory of Elasticity. By A. E. H. Love. Second edition. Pp. xviii+552. (Cambridge: University Press, 1906.) Price 18*s.* net.

INSTEAD of merely revising his former treatise, Prof. Love has written a new one; the result is that we have two works by the same author, in some ways contrasting, in others complementary. And as in the similar cases of Maxwell's "Electricity," and Thomson and Tait's "Natural Philosophy," the prudent will buy the new book without parting with the old.

Naturally one feature in the new edition is the inclusion of important or interesting results obtained since the appearance of the earlier one. In some branches of mathematics the proportion of English workers is distressingly small; but in elasticity this is happily not the case, and the recent researches of Michell, Filon, Dougall, and others, besides those of veterans that need not be named, receive in these pages their due recognition. So also do those of their Continental *confrères*, more particularly Voigt; but it is hard to avoid the impression that the deaths of Kirchhoff and Hertz have left vacancies which have yet to be worthily filled.

It is interesting to compare the historical introduction in its old form with its successor. The former was in some places controversial, and the author seems to have thought some of the statements too dogmatic, at any rate in form. However this may be, the new introduction is strictly impersonal, and shows clearly enough how recent physical theories and discoveries affect the subject of elasticity. A great deal of the polemic about the number of elastic constants was as illogical as the quarrel about *vis viva*. As an abstract

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